Memorandum

U.S. Department
of Transportation

**Federal Aviation
Administration**

Subject: Classification of Design Changes to TSO-C39b, TSO-C127, and TSO-C127a Articles

Date: SEP 8 2003

From: Manager, Aircraft Engineering Division, AIR-100

Reply to
Attn. of: H. Jensen
(202) 267-8807

To: Directorate Managers
Aircraft Certification Office Managers

What is the purpose of this guidance?
This memorandum provides guidance on determining whether a design change to a seat approved under Technical Standard Order (TSO) C39b "Aircraft Seats and Berths" or TSO-C127 "Rotorcraft, Transport Airplane, and Normal and Utility Airplane Seating Systems" or TSO-C127a is considered to be a major change or a minor change with respect to the TSO approval. A TSO approval is a TSO Authorization or a Letter of TSO Design Approval.

What do the current regulations and guidance say?
The regulations for design changes to a TSO article define a major change as any change that is extensive enough to require a substantially complete investigation to determine compliance with the applicable TSO (ref. 14 CFR § 21.611(b)).

Order 8150.1B, Technical Standard Order Program, reiterates the regulatory language of 14 CFR subpart O and adds that a minor design change is one that has little or no effect on the article's ability to meet the requirements of the applicable TSO.

Why is this guidance needed?
Categorizing a design change as either major or minor under the TSO system requires a definition of "substantially complete investigation" as used in 14 CFR § 21.611. Currently, "substantially complete investigation" is being interpreted many ways and this document provides guidance to standardize its meaning as it relates to TSO seats.

What is a design change to a TSO article?
A change to a TSO article is any action that results in the design data (i.e. drawings, specifications, material processes, etc.) or installation limitations necessary to define the article being altered in any manner.

The criteria for classification of design changes are different under the TSO program and the type design (ref. 14 CFR §§ 21.611 and 21.93, respectively). A design change can be classified

as minor under the TSO program but have an appreciable effect on "characteristics affecting the airworthiness of the product" and therefore be classified as major under the type design. Conversely, a design change can be classified as major under the TSO program but result in a minor change under the type design.

Because of the potential for interaction between the occupant of the seat and the aircraft cabin, TSO seats have shown that relatively benign changes under the TSO approval can have major consequence once installed in the aircraft. For example, although a small design change in the seatback angle may have little or no effect on the seat's ability to meet the TSO, its installation forward of an overwing exit could create a non-compliance to emergency egress airworthiness requirements.

How does this guidance clarify whether a design change to a seat is major or minor under the TSO approval?

A change is considered major if it is "extensive enough to require a substantially complete investigation to determine compliance with a TSO". For the purposes of TSO-C39b, TSO-C127 and TSO-C127a, a substantially complete investigation means a comprehensive evaluation was required of the design data (including substantiation data), process specifications, and/or material processes to determine if the seat with the design change still complies with the TSO. For a change to be considered "major", a data package significantly different from the one used with the previously approved seat would need to be developed and submitted to show the "changed" seat complies with the TSO.

What are the specific examples of changes to seats that are considered major and minor?

In general, design changes to TSO-C39b, TSO-C127 and TSO-C127a seats should be classified as follows:

<u>Major design changes</u>

Major design changes are typically limited to changes that effect the primary load path of the seat such as:

1. Significant base material changes to the seat frame.
   Example(s): Metal seat frame to composite seat frame.
2. Significant structural design changes.
   Example(s): Seats with one lateral beam to two lateral beams.
   Changes to lateral beam spacing.
   Floor mounted versus side-mounted legs.
   Adding a swivel, tracking or vertical movement capabilities to a fixed seat.
   Changing the seat attachment from a pedestal to a leg configuration.
   Changing the installation direction such as forward to side or forward to aft.
3. Change from rigid seat frame to energy absorbing seat frame. However, seats that incorporate a design that allows the energy absorber to be disabled in certain configurations can be considered a minor change. For example, some seats use an energy absorber that can be replaced with a solid link on a front row seat to reduce the head path.
4. Significant changes to belt anchor point configuration.
   Example(s): Lapbelt to shoulder harness.

Minor design changes

1. Seat belt changes.
2. Lateral leg spacing changes.
3. Material process changes.
   Example(s): Forging vs. machining, etc.
4. Cross sectional changes.
5. Joint/fitting changes.
   Example(s): Fastening to welding.
   Significant changes to geometry of fitting.
6. Finish trim changes.
7. Changes requiring flammability testing only.
8. Seat weight changes.
9. Seat track changes (revision to installation limitations to add track).
10. Seat track fitting/adapter changes.
11. Seat cushion changes.
12. Seat pans and attachment changes.
13. Arms/consoles and attachment changes.
14. Attachment provision changes for electrical/IFE equipment.
15. Seatback/headrest structure and attachment for forward facing seats.
    Example(s): Addition of energy absorber for HIC compliance.
    Change in recline mechanism and hardware.
16. Changes in seatback breakover, upright position, and recline mechanism/position.
17. Method of attachment of items of mass.
    Example(s): Extinguisher, in-flight entertainment equipment, etc.
18. Changes to life preserver pouch and method of retention of life preserver, raft, etc.
19. Changes to deployable items (retention, injury criteria, egress, etc).
20. Changes to food trays (retention, injury criteria, egress, etc).
21. Electrically operated seat feature changes for weight and retention.
    Example(s): Same seat base frame but change adds control box or actuator for legrest/recline/lumbar/etc to the seat frame.
22. Add-on feature changes that do not change seat design philosophy.
    Example(s): Addition of video, legrests, footrests, telephones.
23. Adding/removing leg pairs which do not change the seat design philosophy.
    Example(s): Center passenger seats in some cases need 4 leg pairs and others require 3 pairs to meet the interface load and TSO requirements.

How are changes that are not in the preceding list classified?
This list covers many changes that occur frequently to seats but it does not cover every possible change to a seat. Also, there are many changes that fall into the "undetermined" category and will need to be evaluated on a case-by-case basis. Questions regarding the classification of these items should be brought to the responsible ACO for discussion and resolution.

Is there a relationship between a "family of seats" and TSO design change classification?
No. It is possible that a minor design change under the TSO approval will cause a seat to fall outside the family of seats in which it was previously substantiated. The design change must be

completely substantiated and may require additional testing but no longer being under the same family of seats has no bearing on its classification as major or minor.

Does testing, including dynamic testing, conducted to substantiate a change automatically classify a change as major?
No. Testing can be used to substantiate minor changes. Changes that in the past were classified as major because a test was used to substantiate the change will not necessarily be considered major changes from this time forward. Tests may be conducted to substantiate a change simply because it is the most effective or efficient way to verify that the change was indeed minor.

For example, from this time forward seat cushion design changes are generally considered minor changes. Static testing, dynamic testing, or analysis in both the 14g down and 16g forward configurations, and flammability testing or analysis will be required to substantiate the change. However the purpose of the testing or analysis is to investigate the effects that the design change to the seat cushion made on the seating system and not to investigate the basic design of the seat that has been previously substantiated.

On the other hand, changing a seat leg from metal to composite is generally considered a major design change. Like the previous example, all of the static and dynamic tests or analysis would have to be completed. In this case the purpose of the testing is to investigate the structural design of the seating system that is fundamental to its performance. The design change cannot be easily determined to effect only limited aspects of the seating system so the testing is required to evaluate the entire design.

Can a series of minor design changes be classified as a major design change?
Yes. The cumulative effect of multiple minor design changes must also be evaluated. Although a series of design changes considered individually may not vary much from the previous change, if considered in total may constitute a major design change when compared to the original approval. After a succession of minor design changes, it is likely that a time will come when most of the original data is not applicable to the seat undergoing the most recent change. At that point, the TSO holder should apply for a new TSO approval.

Do minor design changes have to be substantiated?
Yes. Regardless of the significance of the design change, all design changes must be completely and properly substantiated to the requirements of the TSO.

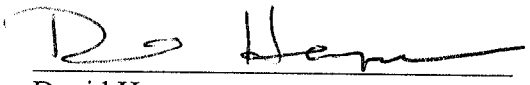
Is a TSO holder required to submit minor design change substantiation data?
Yes. If a Partnership for Safety Plan (PSP) or Memorandum of Understanding (MOU) has been developed and approved between the TSO holder and the appropriate ACO, the ACO may allow the applicant to retain the substantiating data. However the TSO holder must submit the data at the ACO's request. An agreement of this nature must be specified in the PSP or MOU.

When does the data to substantiate minor design changes have to be submitted?
Per Order 8150.1B the data must be submitted within 180 days after making the minor design change.

Does the TSO holder need to notify the installer of minor design changes?
There is no requirement as a TSO holder to notify the installer. However, as a supplier to a certificate holder/applicant, the TSO holder may be required by the certificate holder/applicant's processes or agreements to provide data to support installation approval.

What is the significance of a major design change – what does it mean?
If a design change to a previously approved TSO article is determined to be major, then the article is considered to be a new type or model and the TSO holder must apply for a separate and new TSO approval. This requires that the TSO holder apply for approval to the current revision of the applicable TSO in accordance with 14 CFR § 21.605(a).

Are there other ways of meeting the intent of this memorandum without following the specifics of this guidance?
Yes. Although it may be convenient from a standardization and enforcement perspective to make absolute determinations, that approach limits an engineer's ability to use sound judgement and common sense when evaluating proposed design changes. If it is desired to address design changes differently from this guidance it should be clearly defined and documented by an agreement between the ACO and the seat TSO holder. For example classifying a specific seat part as a major or minor design change differently, adding a process for classification of design changes for TSO relative to type design, stipulating where minor design change data is held, etc., can be accomplished under a coordinated agreement. This agreement is best implemented with a Partnership for Safety Plan (PSP) or Memorandum of Understanding (MOU) that should be established prior to addressing design changes by a means contrary to this guidance. The PSP or MOU should be coordinated with AIR-100 to evaluate any issues pertaining to part 21, subpart "O" and the latest revision to Order 8150 and to maintain consistency with other TSO seat related guidance.



David Hempe
Manager
Aircraft Engineering Division, AIR-100